Rotorua | Kapenga M Trust (#3)

Integrating Forestry for Profitable and Sustainable Land Use

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Te Uru Rākau
Forestry New Zealand

Executive Summary

- Kapenga M Trust farming operations comprise 1,890 ha of Tūhourangi land in Waikite Valley, Rotorua. This includes dairy, sheep and beef, deer, forestry and wetland.

- Three scenarios (S1, S2 & S3) evaluated planting 155 ha of *Pinus radiata* and mānuka on dairy and sheep and beef land.

- Scenario 1 and 2 were equally profitable and more so than the base system with an aggregate net present value over two rotations 9% greater than the current operation. With carbon included, the IRR was 0.5% greater than the base system and total equity after the first rotation was projected to be $1.8 million higher. These figures reflect the greater productivity of trees on land considered marginal for farming.

- Further incorporation of trees on farm supported the Trust's goal of improved environmental sustainability with N and P loss reduced by 9% and 22%, respectively. Biological emissions also reduced by 11%.

- Restoration of the Kapenga wetland was analysed in a standalone section and included native regeneration as well as new native planting at a net cost after grants such as IBT assumed to be able to provide funding of $2,000/ha and $61,475/ha, respectively. Good advice and understanding of the key constraints limiting wetland function is critical to ensure successful restoration.

- Integrating trees on farm is complex. Planning and intergenerational thinking is key and requires consideration of cash flow, capital costs and impacts to the remaining farm system. Environmental and cultural implications of planting should also be considered.

- Planning for right tree, right place and right purpose is fundamental in achieving landowner objectives.

Table 1. Key physical, financial and environmental metrics for the base system and forestry scenario's modelled for Kapenga M Trust.

	Base system	Scenario 1 & 2
Effective area converted to trees (ha)	-	155.0
Effective dairy area (ha)	338.9	▼ 16%
Effective drystock area (ha)	826.3	▼ 12%
Dairy production (kg MS)	299,782	▼ 10%
Drystock production (kg product sold)	167,359	▼ 9%
IRR%	8.5%	▲ 0.6%
Equity at end of first rotation	$36,297,098	▲ 5%
Total N leaching loss (kg N/yr)	48,409	▼ 9%
Biological GHG (t CO2 eq./ha/yr)	3.6	▼ 11%

Case Study Overview

This case study illustrates the impact of integrating various forestry options into a pastoral farm business. The options analysed are specific to the Kapenga M Trust farm and farming aspirations including revitalising the wetland. Financial and environmental analysis demonstrate potential returns, impact on reducing the farm's environmental footprint, and total farm business performance of the integrated options compared to the existing farm system. The full case study report with detailed analysis can be found at www.mpi.govt.nz/forestry/ and www.perrinag.net.nz/planting-trees/.

Sections covered in this case study include:

CURRENT FARM BUSINESS

This section presents a snap shot of the businesses background, goals, and current performance. Data from the 2019/20 season is utilised to form the 'status quo system' to provide a base comparison to the forestry options analysed.

Read more on page 4

RIGHT TREE RIGHT PLACE RIGHT PURPOSE

Factors motivating tree plantings and land use change are outlined to understand 'why' trees are being considered. The property's various land classes are evaluated for their physical characteristics and determining which tree species are best suited. For the Trust as "kaitiakitanga" or guardians of the land for future descendants, the focus is to plant the right tree in the right place to achieve the right purpose.

Read more on page 5-6

WHOLE BUSINESS ANALYSIS – BEST FUTURE LAND USE & FARM SYSTEM

The forestry and environmental planting options are analysed at both an enterprise (farm and forestry) and a whole farm business level to show the performance of each integrated forestry option compared to the status quo and identify which option best supports the attainment of the owners' objectives.

Read more on page 7-14

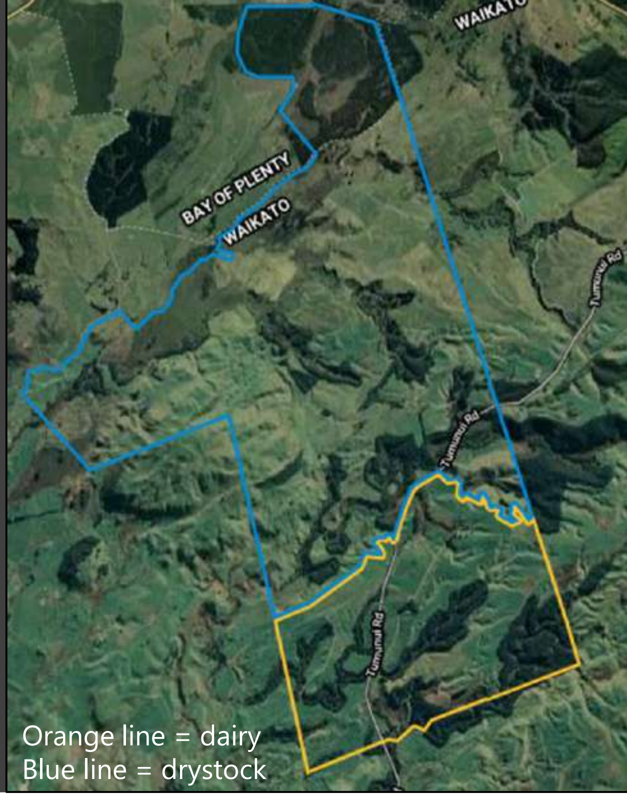
Farm Overview (Status Quo Farm System)

Kapenga M Trust owns 1,890 ha of farm and forestry on Tūhourangi land, 15 km south of Rotorua. The property includes 339 ha of dairy, 635 ha of sheep and beef, 191 ha of deer, 266 ha of forestry, 168 ha of wetland, 78 ha of riparian and 189 ha of scattered native bush and scrub. The farm's topography is 60% flat to rolling with 19% easy hill and 21% steep.

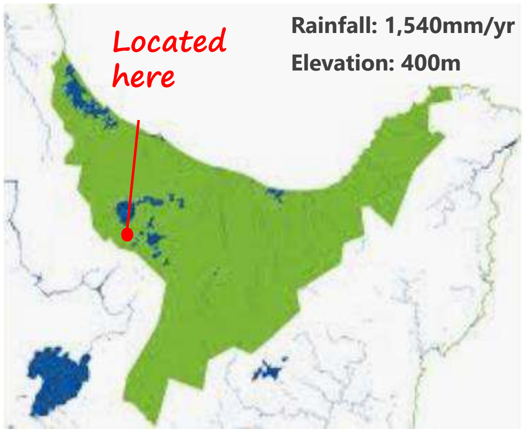
Kapenga M Trust are interested in creating a more environmentally and ethically sustainable farm business with greater incorporation of forestry and native trees on farm. Within the dairy and drystock units, there are areas of steep land with reduced pasture production and feed quality which would be more productive in trees.

The Trust also have a vision to revitalise the wetland which was once "the food bowl of Tūhourangi" to provide a regenerative, natural resource for their people.

Integration of trees on farm offers the opportunity to build environmental resilience, diversify income, enhance the property's biodiversity and aesthetics, and support the farm operation.



Location



Farm Details

Whole farm (ha)	**1,890**
Effective pasture (ha)	**1,165**
Soil type	**Taupo, Oropi and Haparangi soils**
Total milk production (kg MS)	**299,782**
Total drystock production (kg meat, wool & velvet)	**167,359**
Est. pasture production (t DM/ha)	**6 -12 (avg. 8.4)**

Livestock Details

Breed type	**Crossbred**
Dairy herd size	**865**
Production per cow (kgMS)	**347**
Dairy stocking rate (cows/ha)	**2.6**
Drystock stocking rate (SU/ha)	**11.2**
Drystock production per hectare (kg meat, wool, velvet)	**203**
Sheep:cattle:deer ratio	**46:30:24**
Lambing % / Fawning %	**134%/ 80%**

Performance Indicators

Production per hectare (kg MS/ha)	**885**
Operating profit ($/ha)	**$561**
Return on asset (ROA%)	**2%**
N leaching (kg N/ha/yr)	**24**
Dairy N efficiency (kg MS/kg N loss)	**13.4**
Drystock N efficiency (kg product/kg N loss)	**6.2**
Biological GHG emissions (t CO_2 eq./ha)	**3.6**

Factors Motivating Tree Planting and Land Use Change

Physical Constraints

- Significant areas of gullies and steep hill slopes run through the dairy (60 ha) and drystock (100 ha) properties and limit production potential. These areas have low fertility, are dominated by poorer pasture species and have a high incidence of weeds. The Trust are considering increasing their existing forestry woodlot to provide continued diversity of income and more regular timber and/or carbon revenue. The question arises: **“if the less productive areas were retired and planted in trees what would the overall impact be to the business”?**
- The Kapenga wetland is a significant natural and cultural resource. While the wetland is currently in a healthy functioning state, biodiversity values are under threat from weed species including willow, blackberry and gorse which compete with native plant communities. Mustelids and rats also pose a threat to native bird species. Further work to encourage regeneration and new native plantings in wet areas would help to enhance and support biodiversity and ecosystem services, and help to restore the wetland to what was once the ‘food bowl’ of the area.

Environmental Constraints

- Kapenga M Trust operates in the Waikato catchment under the Proposed Waikato Regional Plan Change 1. As is stands, and subject to change, the Plan sets out minimum standards that all farms must comply with including stock exclusions and buffer strips around waterways, restrictions on nitrogen application rates and timing, and restrictions to land use. In addition, all farmers must submit a farm environment plan (FEP).
- While **Greenhouse Gas (GHG) reduction targets** – except nitrogen fertiliser, fuel and electricity – are not yet explicitly in the Emissions Trading Scheme (ETS), all farmers under the **Zero Carbon Act 2019** will need to reduce biogenic methane emissions by 10% by 2030 (December 2017 baseline).
- The **integration of trees** may provide a valuable tool to reduce the farm’s environmental footprint by reducing total farm nitrogen (N) and phosphorus (P) loss as well as reduce biological greenhouse gas emissions.

Right Tree Right Place Right Purpose

Understanding a planting site and its effect on tree performance and future harvesting operations is essential for selecting the right tree to achieve the desired outcomes. In this section the tree options for the different land classes at Kapenga are explained. The property is characterised by distinct land types, the flat to rolling productive land, steeper gully systems and hill slopes and the wetland.

Steep Land

- A combined area of 155 ha of north-facing steep slopes on the dairy and drystock units are prone to drying out over summer and have poor quality and lower producing pasture species.
- Planting these steeper areas provides an opportunity to increase and diversify income generated while reducing sediment and phosphorus runoff.
- Different species lend themselves to different sites with mānuka favoured for smaller blocks next to raceways and *Pinus radiata* on the larger, more accessible areas.

Wetland

- Kapenga has 168 ha of swamp wetland containing extensive areas of sedge *(Carex secta*), harakeke (*Phormium tenax*), mānuka (*Leptospermum scoparium*) and cabbage tree (*Cordyline australis*). Blackberry and gorse, however, threaten native plant communities.
- Additional areas within the wetland would benefit from planting to improve biodiversity, maintain nutrient filtration and wetland function.
- Given the close proximity to the wetland seed source, native regeneration is a good option for native establishment in this area.

Recently Retired Wet Zones

- Recently retired low-lying wet areas have also been considered for wetland planting.
- Unlike the areas within the wetland, new native seedlings are required to establish and restore these wetland areas.
- The area is boggy and requires species such as sedge, harakeke, manuka, mingimingi (*Coprosma propinqua*), kahikatea (*Dacrycarpus dacrydiodes*) and cabbage tree which can tolerate such conditions.

Integrated Forestry Analysis

Kapenga M Trust are interested in trees to support their objectives of providing the maximum benefit to beneficiaries and enhancing and preserving the land as a taonga for future generations. It is envisioned that integrating trees (both native and exotic) on steep hill slopes and in wetland areas will create a diversified farm business with a reduced environmental footprint while at the same time returning part of the land to its original state.

Pinus radiata is an obvious choice for forestry scenario planning due to the strong infrastructure and market channels with several local processors located in Rotorua, 20 km away, and the Port of Tauranga within 100 km of the farm. The species has already proven to be resilient and capable of good growth as noted with previous stands on the property.

Given the Trust's desire to also plant species that were historically present in the area, **mānuka** has been considered for slopes where scale is prohibitive of timber harvesting, where siting of tall-growing timber species is likely to result in negative impacts to farm raceways and fence lines and where the amenity values of farm entrance ways are more suited to natives.

Three scenarios were tested to evaluate the integration of trees. Afforestation was classified as either timber or native. Woodlots were assessed for economic potential (including carbon), while native plantings were included as costs for establishment less any grants available for planting, plus any carbon revenue that may accrue over time if eligible for the ETS.

For this case study, Te Uru Rākau One Billion Trees direct grants or similar were assumed to be secured to subsidise planting. The integrated forestry analysis that follows shows the physical, financial and environmental impact of three forestry options on the farming units and business overall.

Scenario Design

Scenario 1 – Staggered planting

Scenario 1 targets planting 155 ha of marginal steep land with radiata and mānuka plantings. This comprises 56 ha of drystock land and 99 ha of dairy land.

Planted radiata pine woodlots account for 144 ha and range in size from 1.07 ha to 22.24 ha and are planted over a period of four years.

Silviculture regimes occur in line with the age of tree over the whole woodlot estate, and are spread over four years due to the staggered nature of planting. Woodlots were modelled on a planting density of 800 – 850 stems per hectare (sph), pruned in two lifts (age 5 and 7) to over 5.5 m and thinned once to 370 sph at age 10.

Mānuka plantings are located on 11 ha of small, steep areas adjoining dairy raceways where scale is prohibitive for harvesting.

Changes to the dairy enterprise include a reduced pastoral area to 283 ha, peak cow numbers reduced to 784 and stocking rate increased by 0.2 cows/ha given the greater proportion of higher-producing farm land available after retirement of steep land. Total milk production reduced by 9.6% to 271,012 kg MS.

The drystock pastoral area reduced to 727 ha. Breeding ewe numbers declined 18%, while breeding cow numbers declined by 20%. Stocking rate increased slightly to 11.3 SU/ha with the retirement of lower-producing land. Total product produced also decreased by 9.6% to 151,057 kg.

Scenario 2 – Single year planting (measured tree growth)

Scenario 2 follows the same principles as for S1 but with all woodlot trees planted in a single year (Year 2).

Scenario 3 – Single year planting (modelled tree growth)

Scenario 3 was a minor analysis that was based on the same principles as for S2 with the exception that radiata tree growth was based on a productivity model *"Forecaster"* which uses Site Index (the mean top height of the 100 largest trees per hectares at a given reference age - 20 years for radiata pine) and 300 Index (the mean annual volume increment in cubic metres per hectare of a 300 stem per hectare radiata pine stand at 30 years of age) to quantify productivity.

This scenario was modelled to highlight variances that can occur between those predicted by the model and actual returns to the forest owner.

Table 1. Physical summary of the scenarios compared to the base system.

Farm Parameters	**Base System**	**Scenario 1 & 2**
Effective pastoral area (ha)	339	283
Timber Woodlots - Pinus radiata (ha)	56.4	101.4
Native & riparian (ha)	105	116
Peak cows milked	865	784
Stocking rate (cows/effective ha)	2.6	2.8
Production (kg MS)	299,782	270,921
per hectare (kg MS/ha)	884	958
per cow (kg MS/cow)	347	347
Feed eaten		
Dry matter intake (t DM/ha)	12.1	12.8
Imported feed eaten (t DM/ha)	3.4	3.6
Winter grazing (t DM/ha)	0.5	0.5
Pasture eaten (t DM/ha)	8.8	9.3

Results of Forestry Scenario Analysis

Table 3 summarises the investment outcomes from two full forest rotations (plan, grow, harvest, replant, grow, harvest), both excluding and including carbon revenues.

Scenario 1 - Staggered Planting

The net pre-tax undiscounted proceeds from timber plantings only over two rotations and excluding carbon was **$31,848/woodlot ha.** On an annual basis this would be equivalent to $886 ($6/woodlot ha) in present value from the 144 ha planted. Applying a discount rate of 6% provided a positive present value of $14,290 ($99/woodlot ha) and an **internal rate of return (IRR) of 6.1%.**

If the "safe tradeable carbon" from woodlots is sold between year 8 (the point at which carbon can be claimed from radiata stands grown assuming availability of One Billion Trees grants or similar) and year 17 (the "average age" of a radiata forest grown under a 28 year rotation) and carbon captured from eligible mānuka plantings is sold, then the present value of free cash flow over two rotations increases to $376,557 ($2,429/planted ha) and provides an equivalent annuity of $23,344 ($162/woodlot ha). The **IRR generated also increases to 8.9%.**

Scenario 2 – Single Year Planting (measured tree growth)

The financial results from Scenario 2 were similar to that of S1 given it modelled the same area and productivity of trees.

Scenario 3 – Single Year Planting (modelled tree growth)

Forecaster software modelled greater tree growth productivity than what has been measured from past stands at Kapenga. As a result, the net pre-tax undiscounted proceeds from timber only were greater at $38,753/woodlot ha. The IRR also increased to 9.3% with carbon included for both timber and mānuka plantings.

Table 3. Summary of individual performance for each scenario.

Planted Area	Scenario 1 155.0 ha		Scenario 2 155.0 ha		Scenario 3 155.0 ha	
Area in woodlot (P. radiata)	144.0	ha	144.0	ha	144.0	ha
Area in natives (manuka)	11.1	ha	11.1	ha	11.1	ha
Returns over two rotations (56 years)	**Total**	**/woodlot ha**	**Total**	**/woodlot ha**	**Total**	**/woodlot ha**
NET PRE-TAX LOGS (undiscounted)	4,585,379	31,848	4,585,274	31,847	5,579,637	38,753
Present Value for whole term (WACC = 6%)	14,290	99	18,282	127	140,473	976
Internal Rate of Return (IRR)	6.1%		6.1%		6.8%	
	Total	**/planted ha**	**Total**	**/planted ha**	**Total**	**/planted ha**
NET PRE-TAX LOGS & NATIVE PLANTING (undiscounted)	4,555,942	29,393	4,555,837	29,392	5,550,200	35,807.74
Present Value for whole term (WACC = 6%)	- 16,430	- 114	- 12,437	- 86	109,753	762
Internal Rate of Return (IRR)	5.9%		5.9%		6.6%	
	Total	**/planted ha**	**Total**	**/planted ha**	**Total**	**/planted ha**
NET PRE-TAX LOGS, NATIVE PLANTING & CARBON (undiscounted)	5,522,372	35,628	5,518,473	35,603	6,424,332	41,447
Present Value of free cashflow (WACC = 6%)	376,557	2,429	411,133	2,652	507,064	3,271.38
Internal Rate of Return (IRR)	8.9%		8.9%		9.3%	

Impact on the Farm Enterprise

Table 4. Summary of financial performance indicators for Kapenga M Trust.

Farm financial parameters	Dairy		Drystock		Combined	
	Base system	Scenario 1 & 2	Base system	Scenario 1 & 2	Base system	Scenario 1 & 2
Gross farm income ($/ha)	$4,689	$5,053	$1,345	$1,436	$2,318	$2,449
Farm working expenses ($/ha)	$3,538	$3,836	$992	$1,005	$1,732	$1,798
Total cash operating surplus	$385,362	$344,296	$291,953	$290,305	$677,315	$634,601
Change from base system		-$41,066		-$1,648		-$42,714
$/ha	$1,137	$1,217	$370	$399	$593	$628

DRYSTOCK PRODUCTION

The removal of 99 ha of marginal land equated to an annual reduction of 541 t DM. This required a decrease of 17% and 20% to the breeding ewe and beef breeding numbers, respectively. No change was made to the deer and bull enterprises as no forestry was planted on these areas. Stocking rate increased slightly to 11.3 SU/ha with the removal of poorer quality land. Per hectare product produced mirrored this increase with a 2.9% increase in meat, wool and velvet produced. Overall, total product produced reduced by 15.7 t with the removal of 741 SU from the system.

DAIRY PRODUCTION

Total milk production for S1 and S2 decreased by 9.6% to 270,921 kg MS and reflected the decrease in cow numbers. Milk solids per hectare, however, increased by 8% to 958 kg MS/ha highlighting the impact of retiring poor quality land on the remaining per hectare pasture production. This is supported by a 5.6% increase in pasture eaten to 9.3 t DM/ha in S1 and S2.

PROFITABILITY

S1 and S2 generate a 6% reduction in cash operating surplus (-$42,714) from the combined farming enterprise (excluding forestry returns), but provide 6% higher cash returns on a per hectare basis. This is achieved through the retirement of poor producing land which lifts average pasture growth per hectare allowing a higher margin to be generated.

Savings in farm expenditure including one full-time labour unit on the drystock unit, fertiliser, weed and pest control on hill areas, and feed and animal health costs in line with the reduction in stock numbers help to offset the unchanged fixed costs (e.g. administration, insurance) from retiring land to trees.

With less free operating cash flow available it is important to consider the impact to the business on the capacity to pay debt, tax and capital expenditure needs as well as Trust administration and redistribution requirements. Integration of forestry in a sustainable, staggered approach as modelled in S1 may help to alleviate cash flow constraints.

Environmental Performance

Biological Greenhouse Gas (bGHG) Emissions

Biological GHG emissions at a whole property level **reduced by 0.4 t CO_2 eq./ha/yr (-11%)** in both S1 and S2 compared to the base system. This was a result of lower methane emissions from a reduction in total feed intake, and lower nitrous oxide emissions from a reduction in N fertiliser. This decrease is equivalent to an annual **saving of $18,400** at a **carbon price of $25/NZU** if farm enterprises were to become exposed to a liability from biological emissions not able to be offset from sequestered carbon**.**

Water Contaminant Losses (Nitrogen and Phosphorus)

S1 and S2 demonstrated 12% and 6% less N loss from the dairy and drystock units, respectively, bringing the **whole farm reduction to 9%.** Greater reductions were made from the dairy unit as land previously leaching 44 kg N/ha was converted to forestry at an N loss of 3 kg N/ha. Whereas the base N loss on the drystock unit was only 19 kg N/ha.

Modelling indicated a **22% decrease** in the amount of **P loss** to water for both S1 and S2 compared to the base system. P is lost from soil as part of surface runoff during rainfall events with P loss increasing as slope increases. Planting steep slopes reduces these losses as there is less stock tracking and bare soil. This is most notable on Kapenga Dairy where a greater proportion of hill slopes was removed relative to the farm area, and where the hill slopes also had very high Olsen P levels (60 mg/L) which exacerbated P loss.

Table 4. Summary of impact of S1 and S2 on environmental indicators.

Greenhouse Gases*	Base System	Scenario 1 & 2
Total biological GHG (t CO_2 eq./ha/yr)	3.64	3.25
Methane (t CO_2 eq./ha/yr)	2.79	2.50
Nitrous oxide (t CO_2 eq./ha/yr)	0.84	0.75
GHG emissions efficiency on dairy unit (kg CO_2 eq./kg MS)	12.8	12.5
GHG emissions efficiency on drystock unit (kg CO_2 eq./kg product produced)	23.9	24.2

Table 5. Summary of water contaminant losses.

Nitrogen and phosphorus*	Base System			Scenario 1 & 2		
	Dairy	Drystock	Whole Farm	Dairy	Drystock	Whole Farm
Total N loss (kg N)	22,417	25,992	48,409	19,794	24,404	44,198
N loss per hectare (kg N/ha)	44	19	26	39	18	23
N surplus (kg N/ha)	135	53	78	120	49	71
N conversion efficiency	23%	8%	-	23%	8%	-
kg MS/kg N loss	13.4	-	-	15.2	-	-
kg product produced/kg N loss	-	6.4	-	-	6.2	-
Total P loss (kg P)	2,420	2,501	4,921	1,753	2,088	3,841
P loss per hectare (kg P/ha)	4.7	1.8	2.6	3.4	1.5	2.0

Whole Farm Business Analysis

Integration of forestry and mānuka plantings on Kapenga demonstrated improved profitability with a **9% increase in the net present value (NPV) over two forestry rotations which increased to 32% when carbon is sold in both S1 and S2**. Improvement in per hectare productivity after retiring the poorest quality land to trees resulted in an 0.4% increase to the IRR for the remaining farm business relative to the base system, while the **aggregated (farming and forestry) IRR increased by 0.55%.**

Scenario 1 and 2 provide the greatest wealth creation over the first rotation with closing equity at Year 31 of $37.4 million (without carbon) to $38.1 million (with carbon), compared to $28.3 million at Year 0. This is 5% ahead of the base system which had closing equity at Year 31 of $36.3 million. Although the final equity position is similar between scenarios, the cash flow position to achieving this in S2 is much lumpier compared to the staggered planting modelled in S1 especially at key events such as planting and pruning.

The **11% reduction in annual methane and nitrous oxide emissions from the land use change in S1 and S2** may also have significant value if legislation requires farmers to monetarise their biological greenhouse gas emissions. At a carbon price of $25/NZU this would reduce the farm's liability by $18,400 per year.

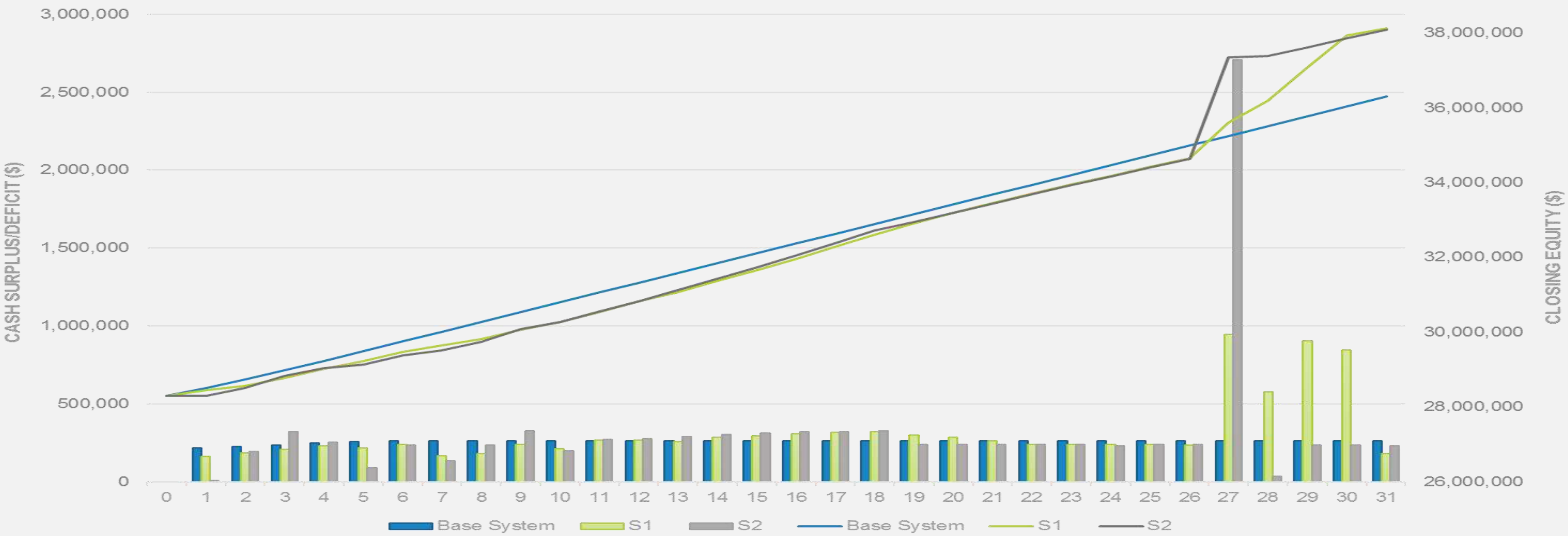


Figure 1. Comparison of total business cash surplus/deficit before principal repayments (LH axis, bars) and closing equity position (RH axis, line) for Scenario 1 and 2 compared to the base system <u>including</u> the sale of carbon at $25/NZU. Note, low closing liabilities ($1,000,000) were assumed on the basis that tenure of the land is Māori Freehold and the Trust are not willing to acquire large amounts of debt against corpus land.

Kapenga Wetland Restoration

A standalone section on restoration of the Kapenga Wetland was also included in this case study.

Unlike many natural wetlands, the Kapenga wetland has been relatively undisturbed. Restoration work is focused on restoring the wetland closer to its original state, keeping in mind its value to iwi as a taonga. It is less about construction work (water regimes and fencing) and more about controlling weeds, maintaining the native plant cover and encouraging these to spread.

This includes establishment of natives around the inner perimeter of the wetland (11.8 ha) to create a buffer for nutrient filtration and sediment capture. These buffers also provide a habitat for bird nesting and opportunity to introduce native plants for cultural resources.

Given the wetland has a large number of native species in close proximity to this buffer, establishing natives via natural regeneration is an appropriate choice. Weed control will be the critical step in ensuring successful regeneration given the current infestation of blackberry and gorse. The cost of native regeneration, net of assumed One Billion Trees grants or similar funding, is estimated at $2,000/ha.

In contrast, the 5.4 ha of recently retired low-lying boggy areas have a relatively low weed presence. However, given a suitable seed source is not within close proximity, establishment through planting of native seedlings is likely to be a more successful approach, although more expensive at an estimated $61,475/ha (net of assumed grants).

Carbon income can be generated from reversion and native planting projects provided they meet the criteria for forest land. In this instance, given the Kapenga wetland is dominated by low-growing shrubs (i.e. <5 m in height at maturity), the native regeneration plantings would not be eligible for the ETS. In contrast, 4.3 ha of the new native planting blocks (only areas that are a minimum of 1 ha are eligible for registration), would be eligible for the ETS provided sufficient tall-growing species are selected. At a carbon price of $25/t, total carbon revenue for this area would be $34,664/ha.

Incentives for native establishment in this case study would therefore not be driven by economics given the large upfront cost of establishing mixed natives (particularly through seedling planting) relative to the low levels of return. Cultural, biodiversity, aesthetic and environmental benefits would instead be the key driver. Further acquisition of funding can however lessen the financial impact of planting and other organisations including local councils, Nga Whenua Rahui and QEII may be able to help as well as provide advice.

Summary

- Incorporation of 155 ha of forestry and mānuka plantings on marginal areas of the dairy and drystock unit, as modelled in S1 and S2, provides the best alignment with the Trust's vision to "strive to provide the maximum benefits to and for the beneficiary owners of Kapenga M Trust". Both scenarios provide the greatest wealth creation over the investment period (two rotations) compared to the base system, and have a positive return on investment if carbon from first rotation forests and mānuka plantings are sold. If carbon is not sold, the IRR is still the same as the current system.

- While carbon provides a good tool for improving cash flow and equity it can only be sold from woodlots in the first rotation. Forestry investments that rely on carbon sales to be profitable may struggle to provide a sufficient return to investors past the first rotation.

- Staggering forestry planting, as modelled in S1, reduces upfront capital costs and spreads the return of cash at harvest over a number of years providing a more consistent cash flow and reducing the need to borrow cash. When incorporated with the existing forestry and farming business, staggered planting can provide a more regular cash flow and buffer against downturns in other areas of the business.

- The forestry scenarios modelled provide environmental benefits with total property N and P loss reducing by 9% and 22%, respectively. Biological emissions (methane and nitrous oxide) also reduced by 11%. These reductions align with the goals and business strategy of Kapenga M Trust to "enhance and preserve the land as a taonga for the benefit of the respective intergenerational descendants".

- Wetland restoration is a long-term process and can have significant costs associated with restoring hydrological regimes, stock exclusion, planting and weed and pest control. Success of projects relies on good advice and mitigating the specific issue constraining wetland function.

- The planning and analysis provided in this case study demonstrates the integration of the **Right Tree** in the **Right Place** to achieve the **Right Purpose** in order to meet the Trust objectives.

Definitions

Actual LWT (Liveweight)	Actual average liveweight of the herd in December.
Stocking rate (SU/ha)	Stock units per hectare based on 550 kg DM eaten per year.
Pasture eaten (t DM/ha)	Measures how much pasture grown that is being eaten and is measured in kilograms or tonnes of dry matter per hectare, standardised at 11 MJ ME/kg DM.
kg DM	Kilograms of dry matter.
kg MS	Kilograms of milk solids (fat + protein).
kg meat and wool	Net increase in kilograms of meat (eg beef/lamb/mutton) and wool grown on farm.
Crossbred	Refers to the progeny of crossing Friesian-Holsteins with Jerseys to produce an animal midway in size between the two parents and with the advantages of both.
Nitrogen loss	An estimate of the N that enters the soil beneath the root zone (>60 cm), expressed as kg N/ha/year.
N surplus	The quantity of N supplied that exceeds plant requirements.
Greenhouse gas emissions (GHG)	Greenhouse gases on a whole farm basis expressed as CO_2 equivalents.
Biological greenhouse gas emissions (bGHG)	A measure of methane (CH_4) and nitrous oxide (N_2O) emitted from a farm as CO_2 equivalents. CO_2 from electricity, fuel, and fertiliser manufacturing is excluded because a levy is applied by the supplier and included in the cost of goods.
FWE (farm working expenses)	Direct farm working costs including owner operator remuneration before depreciation and financial costs.
Operating profit	A measure of farm profitability used for benchmarking comparison between farms. Dairy operating profit is dairy gross farm revenue less dairy operating expenses.
Capital expenditure (CapEx)	Funds used by a business to acquire, upgrade, and maintain physical assets such as property, building, plant and equipment.
Present value (PV)	Is the current value of a future sum of money or stream of cash flows given a specified rate of return. Future values are discounted at the discount rate, and the higher the discount rate, the lower the present value of the future cash flows.
Net present value (NPV)	The different between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyse the profitability of a projected investment or project.
Discount rate	Interest rate used to determine the present value of future cash flows in a discounted cash flow analysis. The weighted average cost of capital (WACC) is commonly used for a businesses discount rate when completing an investment analysis.
Weighted average cost of capital (WACC)	Is a calculation of a businesses cost of capital in which each category of capital is proportionately weighted. All sources of capital are included.
Internal rate of return (IRR)	Used in capital budgeting to estimate the profitability of potential investments. The IRR is a discount rate that makes the net present value (NPV) of all cash flows from an investment equal to zero

Project Details

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